PAUROPSALTA WALKERI, A NEW SPECIES OF CICADA (HOMOPTERA: CICADIDAE: CICADINAE) FROM NORTHERN AUSTRALIA

M.S. MOULDS[1] and C.L. OWEN[2]

[1]*Entomology Department, Australian Museum, 6 College St, Sydney, NSW 2010*
(Email: msmoulds@bigpond.net.au)
[2]*University of Connecticut, Department of Ecology and Evolutionary Biology, 75 North Eagleville Road, Storrs, CT 06269, USA*

Abstract

Pauropsalta walkeri sp. n., a new species of cicada from the tribe Cicadettini, is described. Its distribution extends through a wide area of northwestern Queensland and across the lower 'Top End' of the Northern Territory. An analysis of its song is provided.

Introduction

The genus *Pauropsalta* Goding & Froggatt, 1904, was poorly documented until Ewart (1989) partially reviewed the genus, describing ten new species and with notes on others, including all Queensland species known at the time. Moulds (1990) provided an overview of 13 species but excluding the ten new species described by Ewart, which had been named only a few weeks earlier. Additional notes on Queensland *Pauropsalta* species (mainly concerning songs and distribution) have been published by Ewart (1990, 1998a, 1998b, 2001a, 2001b, 2005), Ewart and Popple (2001), Popple (2003), Popple and Ewart (2002), Popple and Strange (2002) and Popple *et al.* (2008).

Despite the above publications, knowledge of 11 of the described species has remained limited, nothing new having been published on them apart from their brief original descriptions. The identities of these species will be addressed in two forthcoming works: Moulds (in press) and Owen and Moulds (in prep.). In the meantime, we describe here another new species whose distribution is confined to the far north-west of Queensland and the 'Top End' of the Northern Territory.

Terminology for morphological features and higher classification follow Moulds (2005).

The following abbreviations have been used for collections housing specimens: *AE* – collection of A. Ewart; *AM* – Australian Museum, Sydney; *ANIC* – Australian National Insect Collection; *DE* – collection of David Emery, Sydney; *GD* – collection of George Davis, Hobart; *JM* – collection of J. Moss, Brisbane; *JO* – collection of J. Olive; *LP* – collection of Lindsay Popple; *MSM* – collection of M.S. Moulds, Kuranda; *NHM* – Natural History Museum, London; *NTM* – Northern Territory Museum, Darwin; *PH* – collection of Paul Hutchinson; *QM* – Queensland Museum, Brisbane; *WAM* – Western Australian Museum, Perth.

Systematics

Family Cicadidae Latreille

Subfamily Cicadettinae Buckton

Tribe Cicadettini Buckton

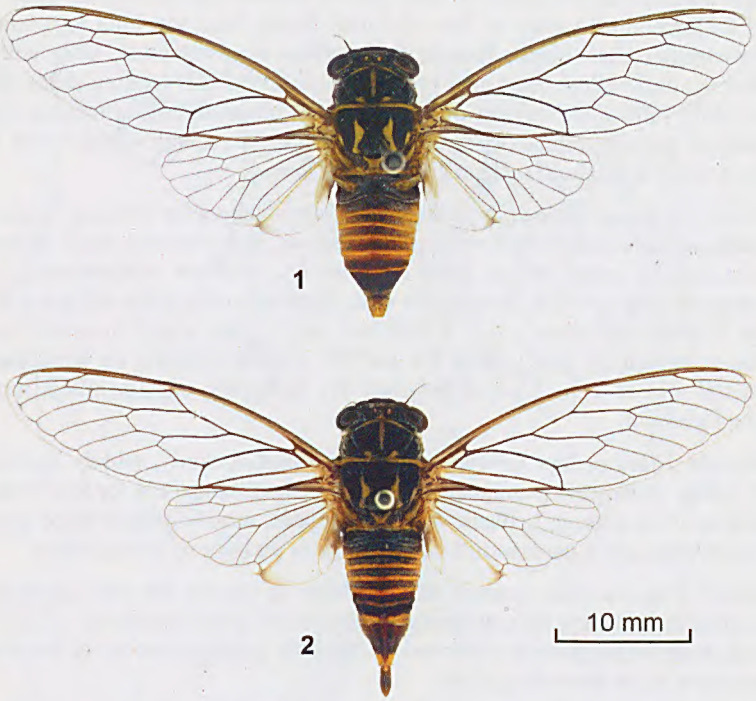
***Pauropsalta walkeri* sp. n.**

(Figs 1-10)

Types. *Holotype* ♂, Walkers Ck, 35 km NNE of Normanton, Queensland, 2.i.1990, M.S. and B.J. Moulds (AM). *Paratypes*: NORTHERN TERRITORY: 1 ♀, Coolabah Ck, WNW of Top Springs, 16°26'S 131°39'E, 24.xii.1991, M.S. and B.J. Moulds; 1 ♂ (genitalia prep. PAU153), 17 km W of Roper Bar, 14°42.355'S 134°24.046'E, 25 m, 3.ii.2006, Hill, Marshall, Moulds (MSM). 1 ♂, Cape Crawford roadhouse, 19.i.2004, Hill, Marshall, Moulds (NTM). QUEENSLAND: 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds; 1 ♂, 18 km east of rd jct to Croydon (at ~8 km S Normanton), 30.i.2002, A. Ewart (AE). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (AM). 1 ♂, 1 ♀, Walkers Ck, 35 km NNE of Normanton, 3.i.1990, M.S. and B.J. Moulds (ANIC). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (DE). 1 ♂, 1 ♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (GD). 1 ♂, 1 ♀, Walkers Ck, 35 km NNE of Normanton, 3.i.1990, M.S. and B.J. Moulds (JM). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (JO). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 3.i.1990, M.S. and B.J. Moulds (LP). 1 ♂ (genitalia prep. PAU151), Walkers Bend, Flinders R., 60 km SSW of Normanton, 14.i.1986, M.S. and B.J. Moulds; 12 ♂♂ (one genitalia prep. PAU150), 5 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds; 17 ♂♂ (one genitalia prep. PAU57), 21 ♀♀, same data except 3.i.1990; 4 ♂♂, 4 ♀♀, same data except 15.i.1992; 18 ♂♂ (one genitalia prep. PAU152), 2 ♀♀, Beames Brook, Burketown/Gregory rd jnct., 20.xii.1991, M.S. and B.J. Moulds; 1 ♀, Combo Waterhole Conservation Park, 140 km NW of Winton, 21°36'03.8"S 142°04'06.4"E, 11.ii.2008, R.B. Lachlan (MSM). 1 ♂, 1 ♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (NHM). 1 ♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 3.i.1990, M.S. and B.J. Moulds (NTM). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (PH). 2 ♂♂, 2 ♀♀, Walkers Ck, 35 km NNE of Normanton, 3.i.1990, M.S. and B.J. Moulds (QM). 1 ♂, 1 ♀, Walkers Ck, 35 km NNE of Normanton, 2.i.1990, M.S. and B.J. Moulds (WAM).

Description. Male (Figs 1, 3-5). Head a little narrower, or about the same width as ampliate lateral margins of pronotal collar; dominantly black. Postclypeus black, the most anterior part usually glossy and often bearing a dull yellow spot; lateral and posterior margins edged dull yellow; transverse ridges and central groove distinct. Anteclypeus black. Rostrum dark brown, darkening towards a black apex; reaching to or just beyond apices of hind coxae. Antennae dark brown to black. Supra-antennal plates usually glossy.

Thorax. Pronotum black with dull orange-yellow markings; anterior margin and much of lateral margin narrowly edged dull orange-yellow; a muddy



Figs 1-2. *Pauropsalta walkeri* sp. n.: (1) male paratype, dorsal view, Walkers Creek, Queensland; (2) female paratype, dorsal view, Walkers Creek, Queensland.

yellow fascia along midline not reaching pronotal collar; pronotal collar between lateral angles dominantly orange-yellow, the anterior margin narrowly edged black broadest around midline; lateral margin of pronotal collar ampliate but restricted anterior to lateral angles. Mesonotum black with orange-yellow markings; an orange-yellow marking on either side following parapsidal sutures and extending to extremities of anterior arms of cruciform elevation, these markings nearly straight along their outer edge, greatly expanded inwards near centre but never meeting; lateral margin with an orange-yellow sub-oval marking; lower ridge of forewing cavity muddy yellow or brownish; midline usually partly marked by a narrow, dull orange-yellow fascia that reaches neither pronotum nor cruciform elevation; cruciform elevation dull orange-yellow (sometimes brown centrally and on basal half to three-quarters of anterior arms and much less so on posterior arms), otherwise black or yellowish brown. Metanotum glossy black at hind wing base, remainder dull orange-yellow.

Legs. Forelegs mostly black or dark brown; femora dull yellow at distal ends and a blurred dull yellow to brown dorsal fascia. Mid and hind legs tending brown rather than black, femora dull yellow at distal ends; tibia with an indistinct dull yellow band near proximal end; distal half tending dull yellow; tarsi dull yellow to varying degrees, mostly on hind tarsi. Pretarsal claws brown on proximal third or so, otherwise black. Meracanthus black with pale yellow apex and lateral margin.

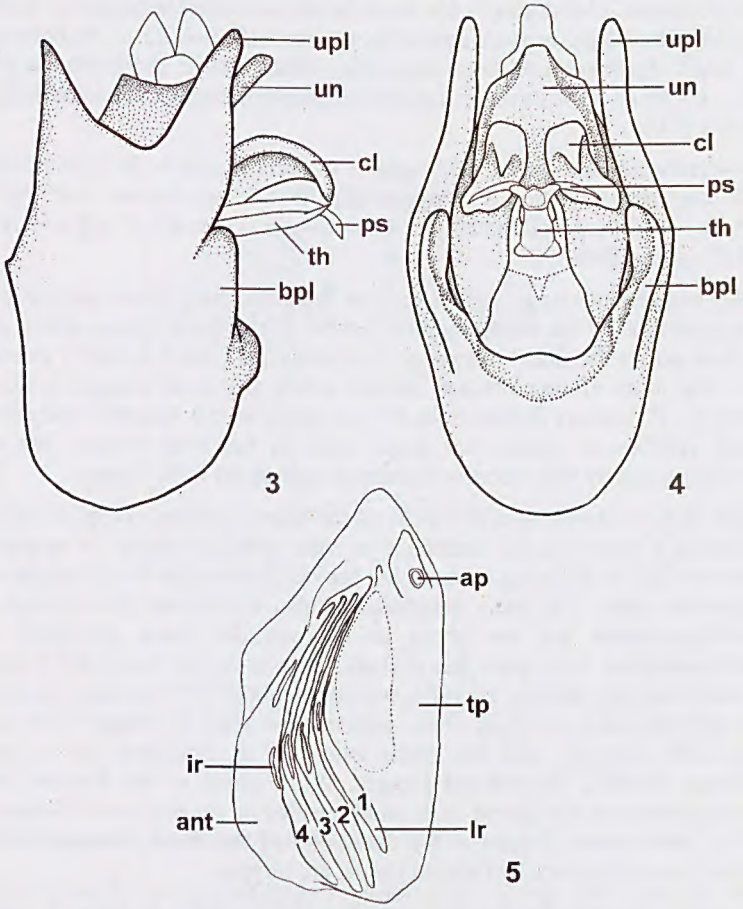
Wings. Hyaline. Forewing with fused stem of veins M and CuA not complete, the veins abutted rather than fused as one; venation black or nearly so except for pale yellow base of vein 1A; without infuscations; basal membrane grey to black, sometimes with hints of brown. Hind wing normally with 5 apical cells (rarely 6 or 4 and then only in one wing); venation brown to black except for pale yellow 2A and 3A; light infuscation on wing margin at distal end of vein 2A and between 3A and wing margin; plaga muddy white to brown.

Opercula. More or less following margin of timbal cavity, widely separated, not tightly closing tympanal cavities; more or less flat except for low rounded swelling of epimeron 3; black with broad, pale, muddy yellow band around distal margin and a narrow dull yellow edge in vicinity of meracanthus.

Timbals (Fig. 5). Pale grey to muddy white in colour, the ribs not heavily sclerotised; four long ribs spanning the width of timbal membrane; short ribs small; anterior membrane wide and completely lacking ribs, at its maximum about as wide as three long ribs.

Abdomen rounded in cross section with epipleurites not reflexed inwards but following curvature of abdomen. Black and orange. Tergite 1 black; tergite 2 mostly black, distal margin narrowly edged dull orange; tergites 3-7 edged orange along their distal margins and almost entirely so sublaterally, anterior margin orange-yellow but usually this pigment is hidden unless abdomen is extended; tergite 8 dominantly black with only a little dull muddy orange distally and ventrally. Sternite I dull orange; sternite II dull orange with small suffusion of black at lateral extremities; sternites III-VIII orange.

Genitalia (Figs 3-4). Pygofer upper lobe long, in lateral view tending slender, tapering to a narrow rounded apex, the distal third or so slightly tilted ventrally. Basal pygofer lobe small, in lateral view broadly rounded. Median lobe of uncus duck-bill shaped, tapering to a broad blunt apex. Claspers claw-like, concave below. Aedeagus with pseudoparameres about as long as theca, slender, flattened in cross section with distal portion gradually tapering to a point, in lateral view positioned about level with thecal shaft and parallel with it, in dorsal view almost parallel to each other but distally curved outwards to about 90°; theca nearly parallel-sided, oval in cross section, apex in lateral view sloping backwards ventrally, distal extremity extended into a pair of delicate, rounded, dorsolateral flanges.



Figs 3-5. *Pauropsalta walkeri*, sp. n.: (3) male genitalia, lateral view; (4) the same, ventral view; (5) left timbal showing ribs. Abbreviations: *ant* anterior part of timbal; *ap* apodeme pit; *bpl* basal pygofer lobe; *cl* clasper; *ir* intercalary rib; *lr* long rib; *ps* pseudoparamere; *th* theca; *tp* timbal plate; *un* uncus; *upl* upper pygofer lobe.

Female (Fig. 2). Similar to male. Abdominal segment 9 dull orange, much of dorsal and half lateral surfaces brown, the brown extending distally in a short linear projection to encompass dorsal beak. Ovipositor sheath long, extending some 1.5 - 2.0 mm beyond apex of abdomen; dark brown to black.

Measurements. Range and mean (in mm) for 10 males and 10 females; includes smallest and largest of available specimens. *Length of body*: male

15.1-19.5 (17.1); female 18.8-22.5 (20.1). *Length of forewing*: male 20.0-24.5 (22.7); female 22.2-25.6 (24.1). *Width of forewing*: male 6.1-8.0 (7); female 6.4-7.8 (7.1). *Ratio width/length of forewing*: male 3.0-3.5 (3.3); female 3.2-3.7 (3.4). *Width of head (including eyes):* male 5.2-6.5 (5.9); female 5.8-6.9 (6.3). *Width of pronotum (across lateral angles):* male 4.9-6.1 (5.7); female 5.4-6.4 (5.9).

Distinguishing characters. *Pauropsalta walkeri* is similar in colour and size to *P. nigristriga* Goding & Froggatt and, to a lesser degree, to *P. infrasila* Moulds, *P. extrema* (Distant), *P. melanopygia* (Germar), *P. elgneri* Ashton and *P. opacus* Ewart.

Males and females of *P. walkeri* can be separated from these species, except *P. nigristriga*, by the narrow yellow border to the postclypeus, which is just as clear across the distal margin as it is along the lateral margins; this is not so in the other aforementioned species where the distal margin is black or partly so. *P. walkeri* differs from *P. nigristriga* in the length of the rostrum, which reaches or passes the distal ends of the hind coxae; that of *P. nigristriga* clearly falls short of the distal ends of the hind coxae.

Males of *P. walkeri* also differ from all the above species, except *P. infrasila*, in having a very rounded abdomen in cross section, where the epipleurites show no sign of reflexing inwards but are confluent with the curvature of the abdominal walls. The male genitalia are also distinctive, the aedeagus has pseudoparameres that are about as long as the theca, in lateral view positioned about level with thecal shaft while in dorsal view almost parallel to each other but distally curved outwards to about 90°; the theca is more or less parallel-sided, oval in cross section, the apex in lateral view slopes backwards ventrally and the distal extremity is extended into a pair of delicate, rounded, dorsolateral flanges. While some of the features of the pseudoparameres are shared with other species in varying combinations, the pair of dorsolateral flanges at the distal end of the theca, rounded in shape and not joined together by flanged tissue, are unique.

Etymology. Named after Frederick Walker (1820-1866), an early pioneer and explorer of the Normanton/Burketown area where the species is common. Walker was commissioned to search for the ill-fated Burke and Wills expedition (no doubt the inspiration for the cicada names *Illyria burkei* and *Tryella willsi*). Walker did not find Burke and Wills but he did find Camp 119, the last Burke and Wills camp before they turned south on their return journey. Walker died of 'Gulf Fever' and is buried on Floraville Station, between Burketown and Normanton. Note that the type locality of *P. walkeri* is Walkers Creek, near Normanton, also named after Frederick Walker.

Distribution (Fig. 6). Northern Territory, where it is known from just three localities: Coolabah Creek near Top Springs, 17 km W of Roper Bar and Cape Crawford roadhouse; and NW Queensland, in the vicinity of Burketown

and Normanton and some 140 km NW of Winton. Near Burketown it is common at Beames Brook south of the town; from near Normanton it is found along the Flinders River SSW of Normanton and at Walkers Creek between Normanton and Karumba, where it is usually abundant. There are records from mid December to early February.

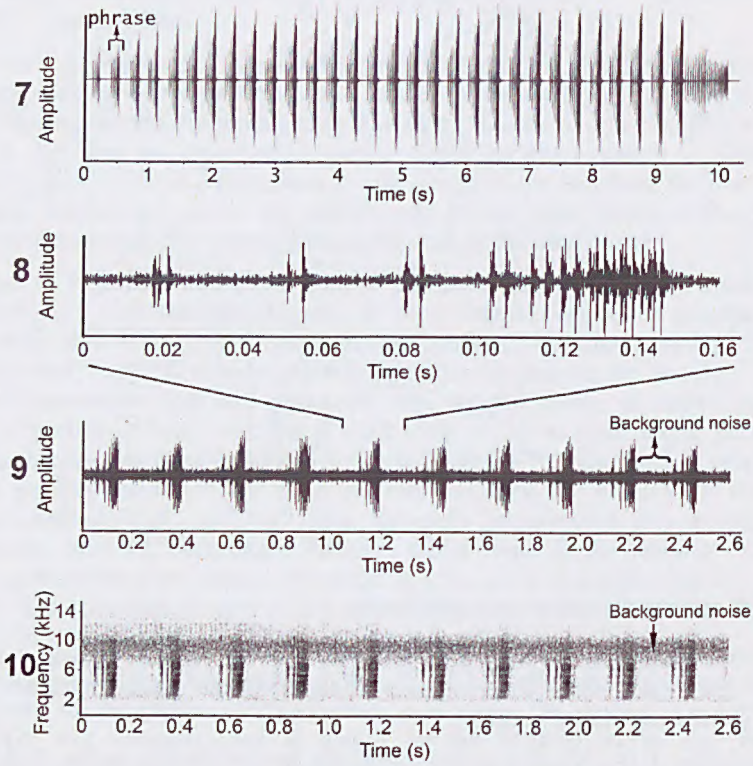
Fig. 6. *Pauropsalta walkeri* sp. n. distribution.

Habitat. Usually in riverine trees (possibly only Myrtaceae) growing along permanent fresh-water watercourses. Adults prefer the smaller branches and are usually out of arm's reach.

Song (Figs 7-10). Singing occurs during the heat of the day and at dusk. To the human ear the song has a somewhat scraping tone and resembles a zick-zick-zick repeated consistently. The song consists of a sequence of rapidly repeated short phrases spaced at approximately 0.22 second intervals (approximately 4.5 phrases per second) apart, each phrase consisting usually of five distinct echemes. In most cases the first three echemes (but sometimes there are two or four) are usually doublets, occasionally triplets. The last echeme consists of multiple pulses, approximately 11-15 in number (Figs 7-9). The distance between echemes decreases with time (Fig. 7). The echemes

forming each phrase gradually increase in amplitude over time (Figs 7-9). Song frequency lies between approximately 2 and 10 kHz.

The sound recording used for Fig. 7 was made with a Sony Walkman cassette recorder WM-D6C model using metal tapes and a Sennheiser K6/ME-66 microphone and for Figs 8-10 using a Marantz 670 digital flash recorder and a Sennheiser ME-62 omnidirectional microphone mounted in a Sony PBR-330 parabolic reflector.



Figs 7-10. Calling song of *P. walkeri* sp. n.: (7) oscillogram of a 10 seconds song segment showing a long sequence of introductory short phrases and a trailing conclusion, unfiltered; (8) oscillogram showing one phrase at a much expanded time scale; (9) oscillogram showing a sequence of ten phrases; (10) sonogram at corresponding time scale to figure 8 showing frequency range, unfiltered. Recording used for Figure 7 by A. Ewart from a caged individual, ~8 km south of Normanton, Queensland, 30.i.2002; recording used for Figures 8-10 by D. Marshall from a field individual, Cape Crawford roadhouse, Northern Territory, 19.i.2004.

Acknowledgments

Song recordings were made by Prof. Tony Ewart, Dr David Marshall and Ms Kathy Hill who kindly allowed us to freely use them and who also assisted us in compiling the oscillograms and spectrogram. For the line drawings we are grateful to Sally Beech and Ivan Nozaic. The Northern Territory Parks and Wildlife Commission kindly provided permits to collect specimens. We thank the National Science Foundation for partial funding of this project from grant numbers DEB 05-29679 and DEB 07-20664. C.L. Owen would like to thank the Lawrence R. Penner Endowment Fund of the Connecticut Museum of Natural History and the Society of Systematic Biologists Graduate Student award, NSF DEB 10-11585, the Systematics Research Fund from The Councils of the Linnean Society and the Systematics Association, and Chris Simon for financial support. For helpful comments on the manuscript we wish to thank Prof. Tony Ewart and two anonymous reviewers.

References

EWART, A. 1989. Revisionary notes on the genus *Pauropsalta* Goding and Froggatt (Homoptera: Cicadidae) with special reference to Queensland. *Memoirs of the Queensland Museum* **27**: 289-375.

EWART, A. 1990. Status of the Germar and Leach types of Australian cicadas (Homoptera) held at the Hope Entomological Collections, Oxford. *Australian Entomological Magazine* **17**: 1-5.

EWART, A. 1993. Cicadas of the Heathlands region, Cape York Peninsula. *Cape York Peninsula Scientific Expedition Wet season 1992 Report*. Royal Geographical Society of Queensland. Volume **2**: pp 135-147.

EWART, A. 1998a. Cicadas of Musselbrook Reserve. In: Musselbrook Reserve Scientific Study Report. *Geography Monograph Series* **4**: 135-138.

EWART, A. 1998b. Cicadas, and their songs, of the Miles-Chinchilla Region. *Queensland Naturalist* **36**: 54-72.

EWART, A. 2001a. Dusk chorusing behaviour in cicadas (Homoptera: Cicadidae) and a mole cricket, Brisbane, Queensland. *Memoirs of the Queensland Museum* **46**: 499-510.

EWART, A. 2001b. Emergence patterns and densities of cicadas (Hemiptera: Cicadidae) near Caloundra, south-east Queensland. *Australian Entomologist* **28**: 69-84.

EWART, A. 2005. Cicadas of the Pennefather River-Weipa areas, October/November 2002, with comparative notes on the cicadas from Heathlands, Cape York Peninsula. *Gulf of Carpentaria Scientific Report*. Royal Geographical Society of Queensland. Pp 169-179.

EWART, A. and POPPLE, L.W. 2001. Cicadas, and their songs, from south-western Queensland. *Queensland Naturalist* **39**: 52-71.

MOULDS, M.S. 1990. *Australian cicadas*. New South Wales University Press, Kensington; 217 pp, 24 pls.

MOULDS, M.S. 2005. An appraisal of the higher classification of cicadas (Hemiptera: Cicadoidea) with special reference to the Australian fauna. *Records of the Australian Museum* **57**: 375-446. *http:/www.amonline.net.au/pdf/publications/1447_complete.pdf*

MOULDS, M.S. In press. A review of the genera of Australian cicadas (Hemiptera: Cicadoidea). *Zootaxa*.

POPPLE, L.W. 2003. Insect of the month. Sprinkler squeaker, *Pauropsalta annulata*. *News Bulletin of the Entomological Society of Queensland* **31**: 128-129.

POPPLE, L.W. and EWART, A. 2002. Cicadas Hemiptera: Auchenorrhyncha: Cicadidae. Pp 113-118, in: Horton, E. (ed.), *A Brisbane bushland: the history and natural history of Enoggera Reservoir and its environs.* Queensland Naturalists Club, Brisbane.

POPPLE, L.W. and STRANGE, A.D. 2002. Cicadas, and their songs, from the Tara and Waroo Shires, southern central Queensland. *Queensland Naturalist* **40**: 15-30.

POPPLE, L.W., WALTER, G.H. and RAGHU, S. 2008. The structure of calling songs in the cicada *Pauropsalta annulata* Goding and Froggatt (Hemiptera: Cicadidae): evidence of diverging populations? *Evolutionary Ecology* **22**: 203-215.